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HANFORD ADVISORY BOARD

A Site Specific Advisory Board, Chartered under the Federal Advisory Committee Act

January 28, 2005

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P.O. Box 47600
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Re: Proposed Plan for Remediation of the 221-U Facility

Dear Messrs. Klein, Schepens, Kreizenbeck, and Ms. Hoffman,

Background

The Hanford Advisory Board (Board) previously advised the Department of Energy (DOE) to make 221-U Facility remediation a priority. Lessons learned from this activity could be germane to other "canyon" facility cleanup. In addition, the analysis of alternatives process resulting in the "Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative) DOE/RL-2001-29" will likely be used as a model for additional canyon clean up plans and remedial actions.

Board Concerns

The Proposed Plan for 221-U remediation raises several concerns, particularly in the lack of breadth and depth of alternative analyses presented in the plan.

- In a review of the Proposed Plan performed by Board members, other reasonable alternatives were identified (see attachment.) As a result, the

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Board is not confident the Proposed Plan contains a sufficiently wide range of alternatives in sufficient detail to present a compelling case for the selection of alternative #6 as the preferred alternative. This gives the impression that a bias towards capping as a solution may have influenced the analysis and selection process.

- The level of analysis presented in this Proposed Plan is not sufficient for use as a "template" for future canyon cleanup plans.

Advice

- A wider range of scenarios should be explored for all alternatives before selecting the preferred alternative and should be clearly communicated for this and all subsequent canyons.
- If the preferred alternative changes as a result of the additional analyses, the Proposed Plan should be revised and reissued for public comment prior to finalization and implementation.
- The Tri-Party Agencies should more clearly identify and communicate how decisions are made in future planning and decision documents.

Sincerely,

Todd Martin, Chair
Hanford Advisory Board

This advice represents HAB consensus for this specific topic. It should not be taken out of context to extrapolate Board agreement on other subject matters.

cc: Howard Gnann, Deputy Designated Federal Official, U.S. Department of Energy
Dan Opalski, Environmental Protection Agency
Michael Wilson, Washington State Department of Ecology
Sandra Waisley, U.S. Department of Energy Headquarters
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Considerations on the Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)

Richard I Smith, P.E.
Robert Davis, PhD
1/09/05

Introduction

The original focus for the Canyon Disposition Initiative was on using the canyon buildings as final receptacles for radioactive waste from throughout the Hanford complex, creating a number of large, above-surface repositories. Initial consideration was given to (a) in situ filling and grouting the intact structures and capping with protective barriers over the structures (Alternative 3); and (b) the same in situ grouted structures surrounded with other site wastes and capping over the buildings and the surrounding wastes with protective barriers (Alternative 4). Also considered were (c) partial dismantlement down to the canyon floor level, with in situ placement and grouting of building wastes into available space below the floor level, and capping over the canyon floor with protective barriers (Alternative 6); and (d) total dismantlement and removal of the structures, with disposal at ERDF (Alternative 1). Of these four alternatives, only Alternative 1 (the total dismantlement and removal option) truly satisfies the HAB's guiding principle of Remove, Treat, and Dispose, with regard to hazardous and/or radioactive wastes. All of these proposed alternatives can satisfy the two essential evaluation criteria set forth by CERCLA for protection of human health and the environment, and for compliance with ARARs. Achieving state and community acceptance for any of the four alternatives should be possible. Thus, one is left with examining the five balancing criteria: long-term effectiveness and performance; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The four alternatives are subjectively compared and ranked, based on the discussions given below for performance under the five CERCLA balancing criteria. Each criterion is assigned an equal weight (1), and the relative evaluation of performance under each criterion is assessed as superior (3), neutral (2), and inferior (1).

Subjective Comparison of CDI Alternatives

Option	Long-Term	Reduction	Short-Term	Implement	Cost	Score
Remove (1)	3	2	1	3	3	12
Intact w/o (3)	2	2	2	2	1	9
Intact w/ (4)	2	2	2	2	1	9
Partial dism. (6)	2	2	2	3	2	11

Thus, under this crude scoring system, the removal option is preferred, with the partial dismantlement option the second choice, and the intact in situ options clearly not preferred.

Performance under CERCLA Balancing Criteria

Long-term effectiveness and performance is similar for all alternatives. The ability to provide long-term protection of human health and the environment is essentially the same for all options, whether the wastes are removed, packaged, and transported to ERDF or are grouted in-place within the canyon building structure. All options utilize a final protective barrier over the residual wastes, whether in ERDF or in situ in the buildings. The principal differences arise in the number and size of barrier caps required. The in situ options require a large cap over each facility, i.e., five large caps to cover U, B, T, Redox, and Purex, while the removal option requires one large cap over the ERDF disposal location. The fraction of ERDF cap area attributable to canyon building disposals would be significantly smaller than the combined areas of the five individual canyon caps, thus releasing more surface area in the central plateau for future beneficial use. Centralizing the wastes within ERDF in the removal option has the advantage of reducing the number of barrier caps that would require surveillance and maintenance in perpetuity.

Reduction of toxicity, mobility, or volume through treatment may be better for the in situ grouted options, compared with the removal option. However, grouting of the packages of waste arising from the removal option prior to transport and disposal would make that option roughly equivalent.

Short-term effectiveness involves consideration of cumulative worker radiation dose, potential for industrial accidents, and perturbation of the natural environment. The estimated worker doses range from about 342 person-rem for the removal option, to about 58 person-rem for the intact in situ options, and about 42 person-rem for the partial dismantlement in situ option. Obviously, the lowest-dose option would generally be preferred. However, there are always ways to reduce the worker dose for a given activity, albeit usually at a greater cost of performance (more remote operations, etc.), so it often becomes a cost-dose tradeoff. The difference in doses between removal and partial dismantlement is about 300 person-rem. The difference in costs between removal and partial dismantlement is about $30 million. Thus, one could spend up to $100,000 per person-rem to reduce the worker dose for the removal option and not exceed the cost of the partial dismantlement option. The removal and partial dismantlement options both entail removing large, heavy roof and wall segments for disposition and would have similar potential risks from industrial accidents. Perturbation of the environment involves the amounts of soil that would have to be removed from some on-site location to fill the excavated cavity after plant removal in the removal option, or to build the barrier cap over the canyon floor and cells for the partial dismantlement option. A volume of 86,900 m^3 is estimated for the removal option, as compared with a volume of 460,000 m^3 estimated for the partial dismantlement option. The other two options require even larger volumes (about 1.4 to 1.5 million m^3). Clearly, the removal option would be preferred to minimize perturbation of the environment.

Implementablity is focused on the difficulty of actually performing the activities necessary to accomplish the disposition option, and all options are considered to be implementable. The removal option presents the fewest potential difficulties for performance, because all of the operations are reasonably well-known. The intact in situ options present somewhat more difficulties in emplacing, grouting, and capping. The partial dismantlement option presents lesser difficulties in emplacing, grouting and capping than the two intact in situ options, but somewhat more difficulty than the removal option.

Cost is always a driver when considering alternatives. The short-term costs for the partial dismantlement option are estimated to be about $73 million, not including about $53 million in long-term monitoring and repair/replacement costs for the cap. The removal option costs are estimated to be about $95 million, not including about $1 million in costs for monitoring and cap repair/replacement of an appropriate portion of ERDF. The estimated costs for the intact in situ options are much higher. Because DOE is most concerned about near-term costs, their preferred option is partial dismantlement. However, for an honest assessment of costs for a project, it is essential to include any future expenditures to develop the total life-cycle cost. When those future costs are included (in current year dollars), the removal option is about $96 million, the intact in situ options are about $175 to $178 million, and the partial dismantlement option is about $126 million. Clearly, from a life-cycle cost viewpoint, removal is the preferred option.

Other Possible Considerations

The approach postulated for the removal option (Alternative 1), was to remove all of the contaminated material/equipment from the canyon deck, from within the hot pipe tunnel, and from within all of the 40 individual process cells, size-reduce that material as appropriate for packaging in maritime shipping containers, and transport the containers to ERDF for disposal. Because of the anticipated high radiation dose rates associated with the equipment to be removed and size-reduced in many of the process cells, the occupational radiation dose estimated to be accumulated by the workers in performing these actions was rather large, about 248 person-rem, or about 72% of the total worker dose accumulation for Alternative 1. There are several possible variations to the current Alternative 1 scenario, described below, which could greatly reduce the worker dose accumulation, and are worthy of evaluation before a preferred approach is selected.

Alternative 1(a): Removal of the Grouted Process Cells in Large Intact Units The size-reduced canyon floor debris and the segmented piping from the hot pipe tunnel are placed into the process cells and the cells are filled with grout. The canyon structure is already divided into 20 segments by expansion joints in the poured concrete; thus these joints would be the obvious places to separate the process cell units. To reduce the size and weight of these segments, the exterior walls would be removed down to the base mat on both sides, and the lower floors and base mat segments outside of the process cell walls would be sawed free and removed in large segments, similar to the above-grade wall segments. The remaining process cell segments, each segment containing 2 process cells, would be removed intact and transported to ERDF for disposal. These segments are large (about 40 ft x 34 ft x 34 ft) and heavy (about 3400 tons each when filled with grout), but are certainly within the capability of large transporter systems available today. The cell segments would weigh about 1/3 as much as the intact production reactor blocks which were postulated to be removed in one piece and transported to the 200 Areas for disposal as the preferred alternative in the Retired Production Reactors EIS, DOE/RL-0119D.

Alternative 1(b): Deferred Removal of the Process Cells The canyon floor debris is size-reduced and placed into process cells. The canyon floor is decontaminated, and the canyon roof is removed in 40-ft segments and placed on the ground. The exterior and canyon walls are removed to the canyon floor level by segmentation into large pieces for disposal. The canyon roof segments are replaced over the canyon floor and grouted into place. A long-lived cover is placed over the existing canyon roof, and the unit remains in passive safe storage for about 75 years (comparable with the retired production reactor safe storage period). Because most of the dose-producing radionuclides are relatively short-lived, the dose rates associated with the hot pipe tunnel and the process cell interiors would have been reduced by about 70% to 80% by decay. Thus, the final removal could be accomplished by removing the grouted canyon roof structure from on top of the canyon floor and segmenting it for disposal. Then, disposal of the lower portion of the canyon building could be accomplished either by (a) removal and size-reduction of material and equipment from the hot pipe tunnel and the process cells, and segmentation of the decontaminated process cells and base mat into appropriately sized pieces for disposal, or by (b) placing the pipe tunnel material into the cells and grouting the cells and removing the process cells in the large segments as described in Alternative 1(a), above.

Either Alternative 1(a) or 1(b) would greatly reduce the accumulated worker radiation dose required to accomplish the disposition of the canyon facility, probably reduce the direct costs, improve the overall effectiveness of Removal as compared with Alternative 6, and could result in Alternative 1(a) or (1b) becoming the preferred alternative for canyon disposition. The proposed Alternative 1b may not be politically correct these days, but the reduction in worker dose achieved by a 70 to 80 year delay in the size-reduction and packaging activities (probably on the order of a 70 to 80% reduction) would bring the estimated worker dose down to the same range as Alternative 6, without the complication of using the very large transporters needed for the intact cell block removals of Alternative 1a. Bottom line estimates for Alternatives 1, 6, 1a, and 1b are summarized in the following table.

COMPARISON OF ALTERNATIVES 1, 6, 1a, and 1b

Alternative	1 (demolish)	6 (partial)	1a (intact cells)	1b (demolish)	1b (intact cells)
Timing	immediate	immediate	immediate	75 yr. decay	75 yr. decay
Cost (a)	95.79	125.87	72.64	121.2	102
Dose (b)	341.37	41.44	79.51	42.3	42

(a) Millions of current year dollars.
(b) Accumulated occupational exposure in person-rem.

The values presented in the preceding table are developed in the two following spreadsheets. These calculations were performed to develop estimated costs and worker doses likely to arise under proposed Alternatives 1a and 1b, by analogy with the values developed for Alternatives 1 and 6 in the Final Feasibility Study for the Canyon Disposition Initiative.

EXAMINATION OF COST DIFFERENCES BETWEEN ALTERNATIVES 1 AND 6, FOR THE PURPOSE OF DEVELOPING COST ESTIMATES FOR THE PROPOSED ALTERNATIVES 1a, b

These data obtained from Table K-5 of the Final Feasibility Study DOE/RL-2001-11 Revision 1
The values examined herein are only those items which had different values in Alternative 1 and in Alternative 6.
Those values which were common to both alternatives comprised about $6.2 million of the total estimated cost in both alternatives.

Alternative	1 (millions)	6 (millions)	1a (millions)		1b (millions)	
Preparatory Activities	13.98	15.61	13.98		13.98	
Canyon Floor and Cells	4.80	1.96	1.96		1.96	
Galleries	0.57	0	0		0	
Hot Pipe Tunnel	0.54	0.14	0.54		0.54	
Ventilation Tunnel Grouting	0	0.5	0		0	
Fix contamination and decon	1.03	0.32	0.32		0.32	
Waste Site Remediation	1.97	0	1.97		1.97	
External Facilities Removal	5.39	20.85	5.39		5.39	
Building Demolition	59.03	10.73	40.00	(a)	59.03	
Fill Galleries	0	1.44	0		0	
Construct Engineered Fill	0	7.42	0		0	
Backfill Excavation Cavity	1.26	0	1.26		1.26	
Construct Engineered Barrier	0	4.11	0		0	
Construct Erosion Protection	0	3.15	0		0	
Revegetat e	0.03	0.05	0.03		0.03	
Establish Monitoring Stations	0	0.3	0		0.3	
Long-Term Monitoring (out-year)	0.51	48.98	0.51		28.97	
Replace Engineered Barrier(500yr)	0.48	4.11	0.48		0.48	
Replace monitoring wells (2 ea.)					0.8	
Subtotals	89.59	119.67	66.44		115.03	
Deltas for Common Costs	6.20	6.20	6.20	(b)	6.20	(b)
Alternative Total Cost (millions)	95.79	125.87	72.64		121.23	(c)

(a) This value is comprised of $10.73M demolition, plus $12.0M for excavation, plus $15.0M for transporter system, plus $2.0M for road construction, derived from DOE/RL-0119D, Decommissioning of Eight Surplus Production Reactors, March 1989, with escalation of 25% since 1989.
(b) The value of $6.20M is based on $6.20M from Alternative1 and $6.20M from Alternative 6.
(c) This value for total demolition following 75 years of decay. Alternative 1b with intact removal of cell blocks might reduce this cost by about $19M, to about $102M.

Performing Alternative 1a would reduce the cost by about 24% compared to Alternative 1, and by about 42% compared to Alternative 6.

EXAMINATION OF DOSE DIFFERENCES BETWEEN ALTERNATIVES 1 AND 6, FOR THE PURPOSE OF DEVELOPING A DOSE ESTIMATE FOR THE PROPOSED ALTERNATIVES 1a, b

These data were obtained from Canyon Disposition Initiative: Preliminary ALARA Evaluation for Final Feasibility Study Alternatives 1, 3, 4, and 6, dated May 31, 2001, and from the Updated Preliminary ALARA Evaluation for Final Feasibility Study, Revision 1, Alternative 6, 7/24/2002.

Occupational Dose from Alternatives (person-rem)	1	6	1a		1b	
BEFORE DECAY						
Remove cell equipment	184.52	22.08	0		0	
Remove deck equipment	10.95	10.95	10.95		10.95	
Clean out Galleries	0.92	0	0.92		0.92	
Fix contamination and decontaminate	7.91	1.26	1.26		1.26	
Building Demolition: Above canyon floor	4.48	4.48	4.48		4.48	
Package and Transport equipment w/o decay)	5.3	2.58	2.58		0.52	(a)
AFTER DECAY						
Package and Transport equipment w/decay					0.41	(a)
Clean out Hot Pipe Trench	38.05	0.09	29.57		5.91	
Building Demolition: Below floor to mat	48.51	0	16.17	(b)	9.70	(d)
Building Demolition: Base Mat	40.73	0	13.58	(c)	8.15	(d)
Total Person-rem	341.37	41.44	79.51		42.30	

(a) The 2.58 person rem is postulated to be split into 0.52 person rem before decay and to 2.06 x 0.2 after.
(b) Assumes demolition of gallery and tunnel walls and floors between the canyon floor and the base mat represents about one-third as much activity as demolition of the galleries, cells and tunnels in Alternative 1.
(c) Assumes demolition of the mat outside of the cell walls represents about one-third as much activity as demolition of the entire base mat in Alternative 1.
(d) Assumes Alternative 1 dose decayed by 80%

Performing Alternative 1a would reduce the dose by more than a factor of 4, compared to Alternative 1, but would increase the dose by nearly a factor of 2 compared to Alternative 6. Alternative 1b would be nearly equal to Alternative 6, and reduce the dose by about a factor of 8, compared to Alternative 1. Intact cell blocks removal after decay would very slightly reduce the Alternative 1b dose.